

AMENDMENTS TO THE CLAIMS:

Please cancel claims 11, 14, 16, 17, 19-21, 23-38, 40-42, 44, 45, 47-60, 63-74, and 76 without prejudice or disclaimer, add new claims 77 and 78, and further amend the claims as follows:

LISTING OF CLAIMS:

1. (Currently Amended) A position determining system comprising:

a first member and a plurality of second members, the first and second members being movable relative to each other and the position of each of the second members relative to the other second members being known;

wherein the first and second members are arranged so that upon the transmission of a signal comprising first and second different frequency components between the first member and the plurality of second members, there is generated a plurality of received signals each associated with a respective transmission path between a respective second member and the first member;

~~means for processing~~ a signal processor operable to process each received signal to determine a corresponding phase measurement for the first frequency component thereof and a corresponding phase measurement for the second frequency component thereof;

a first phase differencing calculator ~~means for calculating~~ operable to calculate, for each received signal, a phase difference between the phase measurements of the first and second frequency components of the received signal, to generate a first set of phase difference measurements;

a first position ~~determining means for determining~~ determiner operable to determine a first position measurement of the relative position of the first member and the plurality of second members from the first set of phase difference measurements and the known relative positions of the second members;

a second phase differencing ~~means for calculating~~ calculator operable to calculate phase difference measurements between phase measurements of frequency components of different received signals, to generate a second set of phase difference measurements;

a second position ~~determining means for determining~~ determiner operable to determine a second position measurement of the relative position between the first member and the plurality of second members from the second set of phase difference measurements and the known relative positions of the second members; and

~~means for determining~~ a third position determiner operable to determine the relative position between the first member and the plurality of second members using the first and second position measurements.

2. (Currently Amended) A system according to claim 1, wherein said ~~relative~~ third position determining means determiner forms part of said second position ~~determining means~~ determiner, wherein said second position measurement includes a phase ambiguity and wherein said ~~relative~~ third position determining means determiner is operable to use the first position measurement to resolve the phase ambiguity associated with the second position measurement to determine the relative position between the first member and the plurality of second members.

3. (Currently Amended) A position determining system according to claim 1, wherein said relative third position determining means determiner is operable to determine the relative position between the first member and the plurality of second members by performing a weighted combination of the first and second position measurements.

4. (Currently Amended) A system according to claim 1, wherein said relative third position determining means determiner is operable to determine the relative position between the first member and the plurality of second members by averaging the first and second position measurements.

5. (Currently Amended) A system according to claim 1, wherein said relative third position determining means determiner forms part of said first position ~~determining means~~ determiner, wherein said first position measurement includes a phase ambiguity and wherein said relative third position determining means determiner is operable to use the second position measurement to resolve the phase ambiguity associated with the first position measurement to determine the relative position between the first member and the plurality of second members.

6. (Currently Amended) A system according to ~~any preceding~~ claim 1, wherein said first position ~~determining means~~ determiner is operable to perform an iterative

processing routine to determine said first position measurement using said first set of phase difference measurements.

7. (Currently Amended) A system according to ~~any preceding~~ claim 1, wherein said second position ~~determining means~~ determiner is operable to perform an iterative processing routine to determine said second position measurement using said second set of phase difference measurements.

8. (Currently Amended) A system according to ~~any preceding~~ claim 1, wherein said first member comprises a transmitter for transmitting said signal and wherein said plurality of second members each comprise a receiver for receiving the transmitted signal and for generating a respective one of said received signals.

9. (Currently Amended) A system according to ~~any of claims~~ claim 1 to 7, wherein each of said plurality of second members comprises a transmitter for transmitting said signal and wherein said first member comprises a receiver for receiving the signal transmitted by each of the second members to generate said received signals.

10. (Currently Amended) A system according to ~~any preceding~~ claim 1, comprising a plurality of first members,

wherein the plurality of first and second members are arranged so that upon the transmission of a signal comprising first and second different frequency components

between each first member and the plurality of second members, there is generated a plurality of sets of received signals, each set being associated with a respective one of the first members and the received signals in each set being associated with the respective transmission path between a respective second member and the associated first member;

wherein said first phase differencing ~~means~~ calculator is operable to calculate a first set of phase difference measurements associated with each first member;

wherein said first position ~~determining means~~ determiner is operable to determine a first position measurement of the relative position of each first member and the plurality of second members from the first set of phase difference measurements associated with the first member and the known relative positions of the second member;

wherein said second phase differencing ~~means~~ calculator is operable to calculate a second set of phase difference measurements for each first member;

wherein said second position ~~determining means~~ determiner is operable to determine a second position measurement of the relative position between each first member and the plurality of second members from the second set of phase difference measurements for the first member and the known relative positions of the second members; and

wherein said relative third position ~~determining means~~ determiner is operable to determine the relative position between each first member and the plurality of second members using the corresponding first and second position measurements.

11. (Canceled)

12. (Currently Amended) The system of claim ~~11~~ 8, wherein a separate ~~processing means~~ signal processor is provided for each receiver which is located at the corresponding receiver and which is operable to determine the phase measurements for the signal received at the corresponding receiver.

13. (Currently Amended) The system of claim ~~11~~ or 12, wherein said ~~calculating means and said determining means~~ position determiner and said phase differencing calculators are located within a central processing station, and wherein said ~~processing means is~~ signal processors are operable to transmit said phase measurements to said central processing station.

14. (Canceled)

15. (Currently Amended) The system of ~~any of claims 11 to 14~~ claim 8, wherein the transmitter is operable to transmit pulses of said signal, wherein said ~~processing means~~ signal processor is operable to determine a phase measurement for the first and second frequency components during each pulse of said transmitted signal, wherein said ~~calculating means is~~ phase differencing calculators are operable to calculate a phase difference ~~measurement~~ measurements for each received signal during each pulse and wherein said ~~determining means~~ first position determiner is operable to determine a position of the transmitter at the time of each pulse on the basis of the

calculated phase difference measurements for the received signals for the corresponding pulse and the known relative positions of the receivers.

16. - 17. (Canceled)

18. (Currently Amended) The system of claim 15, ~~16 or 17~~, wherein said ~~processing means~~ signal processor is operable to determine the phase of each frequency component at each of a plurality of different times during each pulse and wherein said determined phase measurement for each frequency component comprises a phase offset value corresponding to the phase of the respective component at one of said times and a phase slope measurement indicative of the rate at which the determined phase of said frequency component changes during each pulse.

19. - 21. (Canceled)

22. (Currently Amended) The system of ~~any of claims~~ claim 18 ~~to 21~~, wherein said ~~calculating means~~ first phase differencing calculator is operable to calculate a phase difference measurement for both said phase offset measurement and said phase slope measurement.

23. - 38 (Canceled)

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39. (Currently Amended) The system of ~~any of claims 11 to 38~~ claim 8, wherein said receivers are unsynchronised and further comprising a reference transmitter whose position relative to said receivers is known and operable to transmit a reference signal having first and second frequency components with a frequency spacing therebetween, wherein said plurality of receivers are operable to receive the reference signal transmitted from the reference transmitter, wherein said ~~processing means~~ signal processor is operable to process the reference signal received at each receiver to determine for each received reference signal, a phase measurement for the first frequency component and a phase measurement for the second frequency component, wherein said ~~calculating means~~ first phase differencing calculator is operable to calculate a phase difference measurement for each received reference signal from the determined phase measurements for the corresponding received reference signal and further comprising:

~~means for determining~~ a calibration value calculator operable to calculate a respective calibration value for each receiver from the calculated phase difference measurements for the received reference signals, the known relative positions of the receivers and the known relative position of the reference transmitter; and

~~means for adjusting~~ a calibrator operable to adjust said phase measurements using said calibration values to account for the lack of synchronisation of said receivers.

40. - 42. (Canceled)

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43. (Currently Amended) The system of ~~any of claims 11 to 42~~ claim 8, wherein said transmitter is a transmit-only transmitter and operates asynchronously with respect to said receivers.

44. - 45. (Canceled)

46. (Currently Amended) The system of any of ~~claims 11 to 45~~ claim 8, wherein said ~~determining means is~~ position determiners are operable to determine a two-dimensional position of said transmitter.

47. - 60. (Canceled)

61. (Currently Amended) A position processor for determining the relative position between a first member and a plurality of second members, the first and second members being movable relative to each other and the position of each of the second members relative to the other second members being known and the first and second members being arranged so that upon the transmission of a signal comprising first and second different frequency components between the first member and the plurality of second members, there is generated a plurality of received signals each associated with a respective transmission path between a respective second member and the first member, the position processor comprising:

a first phase differencing ~~means for calculating~~ calculator operable to calculate,
for each received signal, a phase difference between a phase measurement of the first

and second frequency components of the received signal, to generate a first set of phase difference measurements;

a first position ~~determining means for determining~~ determiner operable to determine a first position measurement of the relative position of the first member and the plurality of second members from the first set of phase difference measurements and the known relative positions of the second members;

a second phase differencing ~~means for calculating~~ calculator operable to calculate phase difference measurements between phase measurements of frequency components of different received signals, to generate a second set of phase difference measurements;

a second position ~~determining means for determining~~ determiner operable to determine a second position measurement of the relative position between the first member and the plurality of second members from the second set of phase difference measurements and the known relative positions of the second members; and

~~means for determining~~ a third position determiner operable to determine the relative position between the first member and the plurality of second members using the first and second position measurements.

62. (Currently Amended) A position ~~determining system~~ according to ~~claims 60-61~~ or claim 61, further comprising ~~means for processing~~ a signal processor operable to process each received signal to determine a corresponding phase measurement for the first frequency component thereof and a corresponding phase measurement for the second frequency component thereof.

63. - 74. (Canceled)

75. (Currently Amended) A receiver for receiving a plurality of signals transmitted from a plurality of transmitters located at different locations, each transmitter being operable to transmit a signal having first and second different frequency components, the receiver comprising:

~~means for receiving~~ a signal receiver operable to receive the signal transmitted by each transmitter;

~~means for processing~~ a signal processor operable to process each received signal to determine a corresponding phase measurement for the first frequency component thereof and a corresponding phase measurement for the second frequency component thereof;

a first phase differencing ~~means for calculating~~ calculator operable to calculate, for each received signal, a phase difference between the phase measurements of the first and second frequency components of the received signal, to generate a first set of phase difference measurements;

a second phase differencing ~~means for calculating~~ calculator operable to calculate phase difference measurements between phase measurements of frequency components of different received signals, to generate a second set of phase difference measurements; and

~~means for outputting~~ an output operable to output said first and second set of phase difference measurements for transmission to a central position processor.

76. (Canceled)

77. (New) A position determining method for determining the relative position between a first member and a plurality of second members, with the first and second members being movable relative to each other and with the position of each of the second members relative to other second members being known; the method comprising:

transmitting a signal comprising first and second different frequency components between the first member and the plurality of second members;

receiving a plurality of signals, each associated with a respective transmission path between a respective second member and the first member;

processing each received signal to determine a corresponding phase measurement for the first frequency component thereof and a corresponding phase measurement for the second frequency component thereof;

calculating, for each received signal, a phase difference between the phase measurements of the first and second frequency components of the received signal, to generate a first set of phase difference measurements;

determining a first position measurement of the relative position of the first member and the plurality of second members from the first set of phase difference measurements and the known relative positions of the second members;

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calculating phase difference measurements between phase measurements of frequency components of different received signals, to generate a second set of phase difference measurements;

determining a second position measurement of the relative position between the first member and the plurality of second members from the second set of phase difference measurements and the known relative positions of the second members; and

determining the relative position between the first member and the plurality of second members using the first and second position measurements.

78. (New) A computer readable medium storing computer executable instructions for causing a programmable computer device to determine the relative position between a first member and a plurality of second members, the first and second members being movable relative to each other and the position of each of the second members relative to the other second members being known and the first and second members being arranged so that upon the transmission of a signal comprising first and second different frequency components between the first member and the plurality of second members, there is generated a plurality of received signals each associated with a respective transmission path between a respective second member and the first member, the computer executable instructions comprising:

instructions for calculating, for each received signal, a phase difference between a phase measurement of the first and second frequency components of the received signal, to generate a first set of phase difference measurements;

instructions for determining a first position measurement of the relative position of the first member and the plurality of second members from the first set of phase difference measurements and the known relative positions of the second member;

instructions for calculating phase difference measurements between phase measurements of frequency components of different received signals, to generate a second set of phase difference measurements;

instructions for determining a second position measurement of the relative position between the first member and the plurality of second members from the second set of phase difference measurements and the known relative positions of the second member; and

instructions for determining the relative position between the first member and the plurality of second members using the first and second position measurements.